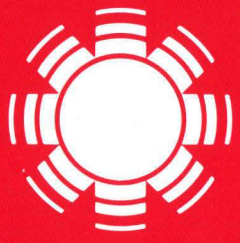
SERI/MR-13-317

July 1979

Wind Energy Innovative Systems Technical Status Report

April 1979

Irwin E. Vas
Richard L. Mitchell



SERI

Solar Energy Research Institute
A Division of Midwest Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

Operated for the
U.S. Department of Energy
under Contract No. EG-77-C-01-4042

NOTICE

SERI/MR-13-317
UC CATEGORY: UC-60

WIND ENERGY INNOVATIVE SYSTEMS TECHNICAL STATUS REPORT APRIL 1979

IRWIN E. VAS
RICHARD L. MITCHELL

JULY 1979

PREPARED UNDER TASK NO. 1321

Solar Energy Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

A Division of Midwest Research Institute

Prepared for the
U.S. Department of Energy
Contract No. EG-77-C-01-4042

FOREWORD

This technical status report was performed in compliance with Contract Number EG-77-C-01-4042 for the Division of Solar Technology of the U.S. Department of Energy. The report was prepared by the Staff of the Special Programs Office of the Solar Energy Research Institute, a Division of Midwest Research Institute.

Report No: SERI/MR 13-317
Date: July 1979

Period Covered: April 1-30, 1979

Program: Wind Energy Innovative Systems
Special Programs Office

Task: 1321.01

Contract: EG-77-C-01-4042
Start Date: November 1977
Completion Date: Continuous
Contractor: Solar Energy Research Institute
1536 Cole Boulevard
Golden, Colorado 80401

Irwin E. Vas
Systems Analysis Branch

Approved for:

SOLAR ENERGY RESEARCH INSTITUTE

E. L. Dowty
Special Programs Office

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SECTION 1.0

PROGRAM OVERVIEW

The Solar Energy Research Institute (SERI) is authorized by the U.S. Department of Energy (DOE) to provide technical management of the Wind Energy Innovative Systems (WEIS) program which is currently comprised of eight research and development contracts and six short term generic studies. These research efforts are aimed at determining technical and economic feasibility of innovative concepts and systems utilizing wind energy.

The Technical Status Report is a monthly publication that reviews the progress and areas of concern associated with each project and presents the financial status of the program. This report reviews the progress of the continuing projects for the period April 1-30, 1979. A list of the projects (Table A-1) and a summary of the WEIS program indicating important milestones for the projects (Figure A-1) are presented with this report.

Major events and areas of concern of the program for the reporting period are as follows:

Major Events:

Completed and presented a paper entitled "A Review of the Wind Program at SERI" at the American Wind Energy Association Conference.

Received DOE approval for the follow-on contract on the investigation of the "Diffuser Augmented Wind Turbine" by Gumman Aerospace Corp. at a funding level of $90.4K.

Areas of Concern:

None

Listing of Current Contracts for the WEIS Program:

The Special Programs Office is managing 14 projects in the Wind Energy Innovative Systems program at the present time. A list of these projects with the basic nomenclature that will be used in subsequent sections of this report is provided in Table A-1. Also presented in the table are the costs, current and total-to-date.

Program and Project Summary Review:

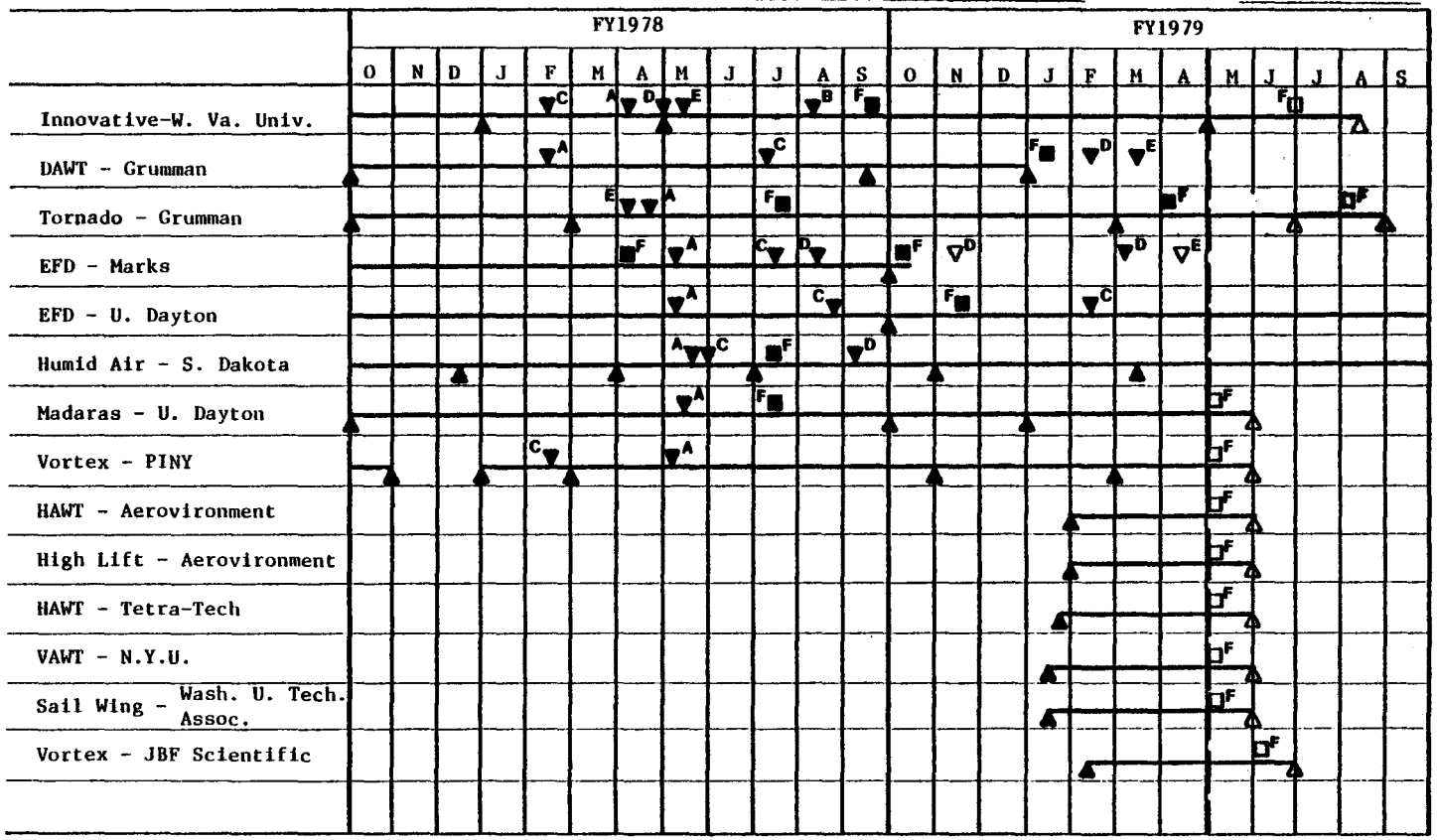
A schedule of important events for all of the WEIS projects is presented in Figure A-1 for FY78/FY79. The period of performance, and major task milestones (planned and completed) are identified in the figure.

Table A-1. PRINCIPAL SUBCONTRACTORS FOR FY79 PROJECTS

Project Title	Subcontractor	Project Code	Contract No.	Principal Investigator	funding level current/total
Innovative Wind Turbine	West Virginia University	WVU	EY-76-C-05-5135	Richard E. Walters	99,888/412,641
Diffuser Augmented Wind Turbines (DAWT)	Grumman Aerospace	G-D	EY-76-C-02-2616. A001	Ken Foreman	201,964/467,931
Tornado-Type Wind Energy Systems Phase II (Tornado)	Grumman Aerospace	G-T	EX-76-C-01-2555	James T. Yen	236,115/434,710
Tests and Devices for Wind/ Electric Power Charged Aerosol Generators (EFD)	Marks Polarized	MP	EG-77-C-01-2774	Alvin M. Marks	99,400/199,200
Electrofluid Dynamic Wind Generator Program (EFD)	University of Dayton	UDE	EH-9-8874-1	John E. Minardi	117,523/314,817
Energy from Humid Air (Humid Air)	South Dakota School of Mines and Technology	SD	DE-AC01-79ET23052	Thomas K. Oliver	68,975/168,522
The Madaras Rotor Power Plant Phase I (Madaras)	University of Dayton Research Institute	UDM	EX-76-S-01-2554	Dale H. Whitford	143,170/143,170
Vortex Augmentors for Wind Energy Conversion (Vortex)	Polytechnic Institute of New York	PINY	E(49-18)2358	Pasquale M. Sforza	43,924/379,927
A Definitive Generic Study of Augmented Horizontal Axis WES (HAWT)	Aerovironment, Inc.	AH	AH-9-8003-1	Peter Lissaman	21,827/ 21,827
A Definitive Generic Study of High Lift Device WES (High Lift)	Aerovironment, Inc.	AHL	AH-9-8003-2	Peter Lissaman	22,772/ 22,772
A Definitive Generic Study of Augmented Horizontal Axis WES (HAWT)	Tetra-Tech, Inc.	TT	AH-9-8003-3	Mark Harper	24,677/24,677
A Definitive Generic Study of Augmented Vertical Axis WES (VAWT)	New York University	NYU	AH-9-8003-4	Martin Hoffert	24,951/ 24,951
A Definitive Generic Study of Sail Wing WES (Sail Wing)	Washington University Technical Associates	WUTA	AH-9-8003-5	K. H. Hohenemser	22,500/ 22,500
A Definitive Generic Study of Vortex Extraction WES (Vortex Extraction)	JBF Scientific Corp.	JBF	AH-9-8003-6	Theodore R. Kornreich	24,950/ 24,950

CONTRACT NO. EG-77-C-01-4042 PRINCIPAL INVESTIGATOR Irwin E. Vas

CONTRACTOR SPO/SERI TITLE Wind Energy Innovative Systems PHONE NO. (303) 231-1935



A Contract Review, Site Visit

B Semi-Annual Report

C Proposal Submission

D Proposal Resubmission

E Procurement Initiation

F Draft Final Report

G Final Report

EXPLANATION

▽ Intermediate Event

△ Milestone

□ Report

Delivered-Filled Symbol
Planned-Open Symbol

Figure A-1. MAJOR MILESTONE CHART FOR WEIS PROJECTS IN FY78 AND FY79.

To facilitate organization of the material in this status report by project, figures are numbered according to project number. Figure 1-1, therefore, is the first figure for project 1.0, and is followed by Figure 1-2, 1-3, etc. Exceptions to this numbering system are Figures A-1 through A-3 which are not project-related. The "A" is used to designate the difference between the program-related figures and the project-related figures. Table A-1, likewise, is program-related.

SECTION 2.0

WIND ENERGY INNOVATIVE SYSTEMS

PROJECT SUMMARY

SERI is responsible to DOE for technical management of the WEIS program. This program includes eight research and development contracts and six short-term generic studies. This section reviews the current technical status of the overall WEIS program and the individual 14 projects.

Each project is reviewed on a project status sheet which is followed by a project milestone chart and a project cost management chart. Each project status sheet is comprised of a project description and the following six sections:

Contract Objective
Contract Tasks (Accomplishments)
Technical Approach or Work Plan Changes
Variances
Open Items
Summary Status Assessment and Forecast

Under the Contract Tasks heading, tasks are defined and task accomplishments discussed with the task numbers, given in parenthesis, following each task statement. These provide the reader with a reference to the description of each project task and are either given in previous Wind Energy Innovative System Technical Status Reports, or defined under the Contract Tasks heading of the appropriate project status sheet.

The milestones listed below are indicated on the milestone chart presented in this section for the program and for each project. These will be modified as deemed necessary in the future reports.

(1) Task completion.
(2) Task stopped and redirected.
(3) Redirected effort.
(4) No cost extension provided.
(5) Draft final report submitted.
(6) Site visit-project review.
(7) Wind tunnel phase completion.
(8) Preliminary design review.
(9) Design review.
(10) Terminated due to DOE decision.
(11) Method validated.
(12) Results analyzed.
(13) Task completed during previous fiscal year.
(14) Final report.
(15) Monthly report.
(16) Quarterly report.
(17) Draft final report review completed.
(18) Final report submitted.
A. Task of project to be funded; contract negotiations underway.

Project Title: Wind Energy Innovative Systems (WEIS)
Contract: WEIS Program Management

Number: EG-77-C-01-4042
Start Date: November 1977
Completion Date: Continuous

Contractor: Solar Energy Research Inst.
1536 Cole Blvd.
Golden, CO 80401

Contract Objective

Determine technical and economic feasibility of innovative wind energy systems.

Contract Tasks (Accomplishments)

Completed the internal technical review of the 37 proposals received in response to the RFP, RH-9-8085, entitled "Advanced and Innovative Wind Energy Concept Development". (Task 7)

Completed technical reviews of the unsolicited proposals by R. Henderson (Wind-Ammonia Turbine) and J. Knecht (A New Approach to Harnessing the Power in the Wind). (Task 6)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The proposals received in response to RFP RH-9-8085 are to be evaluated by an external committee and rank ordered during May 1979.

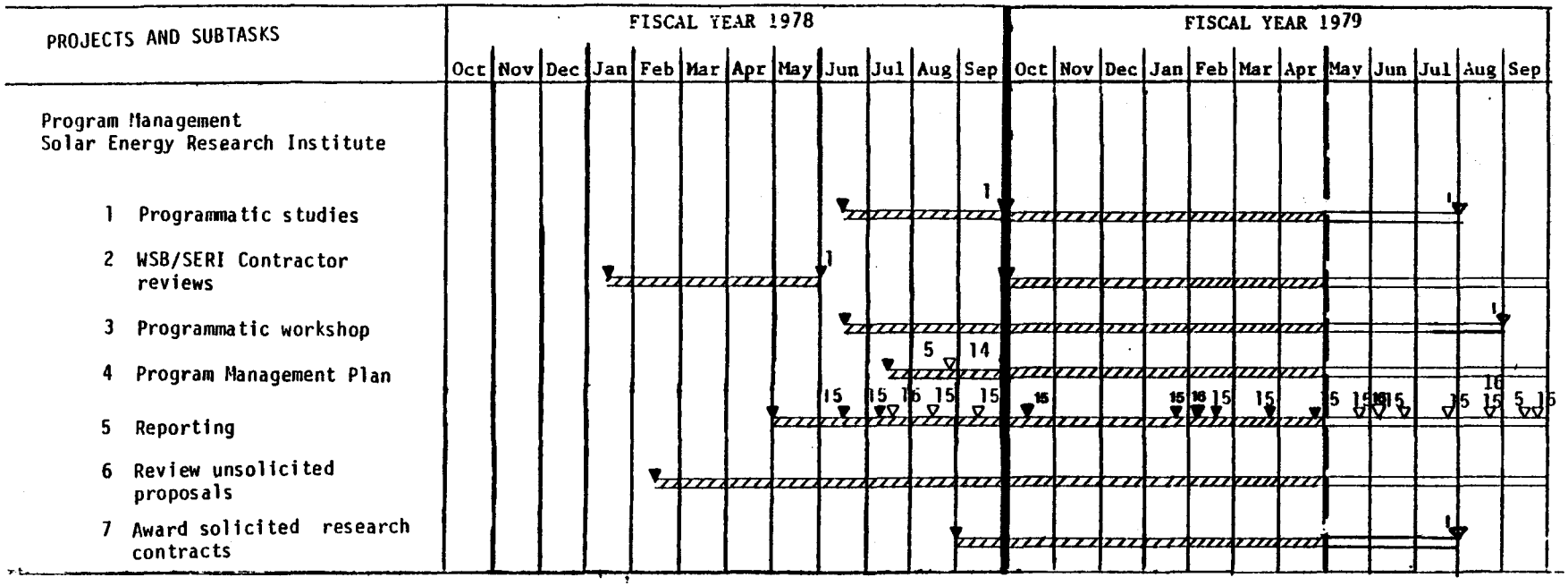


Figure A-2 FY78 and FY79 Milestone Chart for SERI Wind Energy Innovative Systems Program Management

1. Contract Identification	2. Reporting Period	3. Contract Number
WIND ENERGY INNOVATIVE SYSTEMS	APRIL	EG-77-C-01-4042

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
SOLAR ENERGY RESEARCH INSTITUTE 1536 COLE BLVD. GOLDEN, CO 80401	OCTOBER 1, 1979	CONTINUOUS

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													

a.

e. Actual Costs Prior FYs: -

f. Planned Costs Prior FYs: -

g. Total Estimated Accrued Costs for Contract: $516,200

h. Total Contract Value: $516,200

Accrued Costs ($K)	O	N	D	J	F	M	A	M	J	J	A	S
b. Planned	40	76	112	145	203	265	336	406	454	481	500	516
c. Actual	36	69	89	121	185	250	328					
d. Variance	-4	-7	-23	-24	-18	-15	-8					

FIGURE A-3 FY79 Cost Management Chart fot the SERI Wind Energy Innovative Systems Program Management

Project Title: Innovative Wind Turbines
Contract: Project 1

Number: EY-76-C-05-5135
Start Date: March 1, 1975
Completion Date: August 15, 1979

Contractor: West Virginia University
Morgantown, WV 26506

Contract Objective

Investigate the technical and economic feasibility of a vertical axis wind turbine having straight blades constructed with circulation control airfoil sections.

Contract Tasks (Accomplishments)

Circulation controlled blade construction is 99% complete. (Task 1.8)

Completed the aerodynamic tare measurements for the rotating support arms. Continued rotational testing for the conventional blades up to 80 rpm with an 8-ft. radius support arm. No difficulties or vibrations were observed. Testing is underway to measure blade lift, drag, and pitching moment. (Task 1.9)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

The final report which includes the results of Tasks 1.1 to 1.6 is to be delivered in June 1979.

Summary Status Assessment and Forecast

The project is to be completed as scheduled, August 15, 1979.

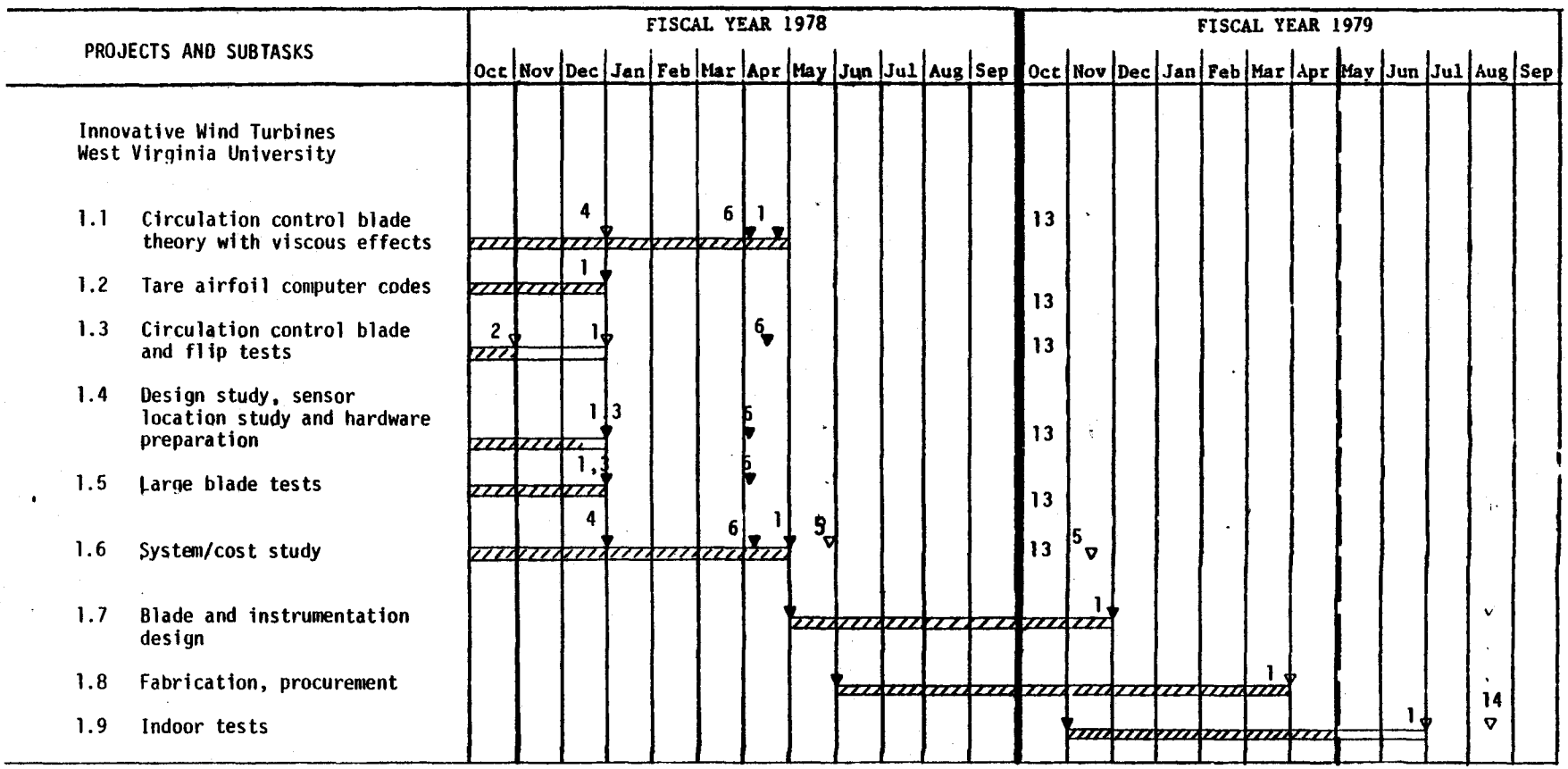
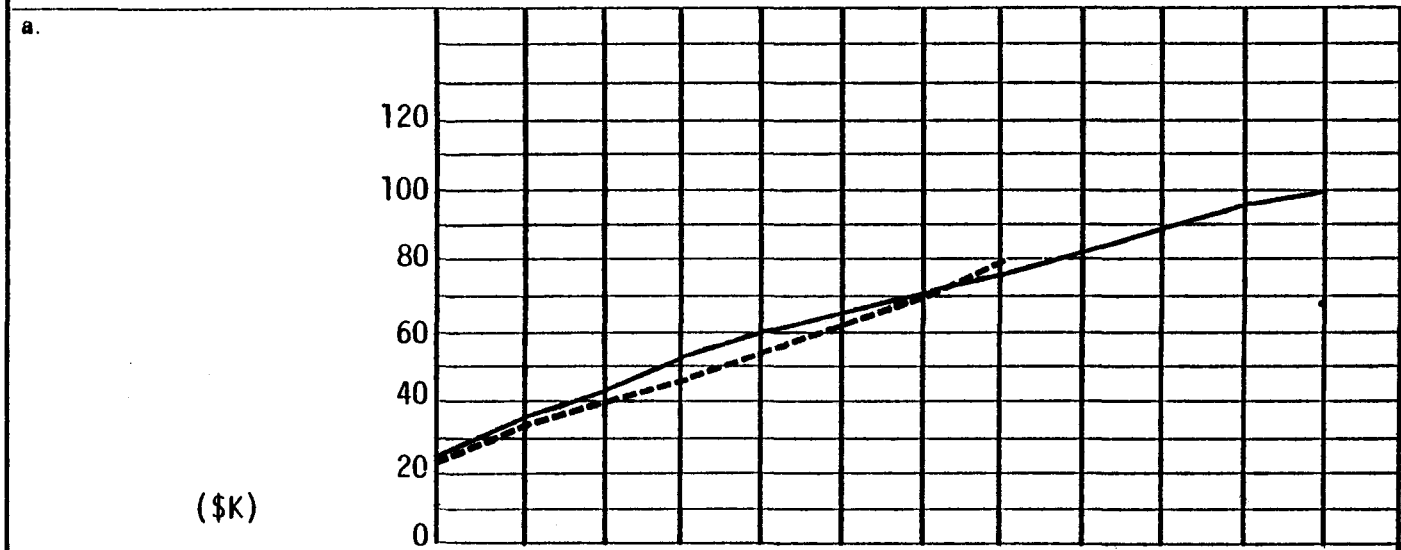


Figure 1-1 FY78 and FY79 Milestone Chart for the Innovative Wind Turbines Project

1. Contract Identification	2. Reporting Period	3. Contract Number
INNOVATIVE WIND TURBINES	APRIL	EY-76-C-05-5135

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
DEPARTMENT OF AEROSPACE ENGINEERING WEST VIRGINIA UNIVERSITY MORGANTOWN, WV 26506	MARCH 1, 1975	AUGUST 15, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a.													
b. Planned	35	43	52	60	66	71	76	82	89	96	100		
Accrued Costs c. Actual	33	40	45	54	62	70	79						
d. Variance	-2	-3	-7	-6	-4	-1	3						



e. Actual Costs Prior FYs: $412,641

f. Planned Costs Prior FYs: $412,641

g. Total Estimated Accrued Costs for Contract: $ 99,888

h. Total Contract Value: $ 99,888

FIGURE 1-2 FY79 Cost Management Chart for the Innovative Wind Turbines Project

Project Title: Further Investigations of Diffuser Augmented Wind Turbines
Contract: Project 2

Number: EY-76-C-02-2612 A001
Start Date: September 26, 1977
Completion Date: December 31, 1978

Contractor: Grumman Aerospace Corp.
South Oyster Bay Road
Bethpage, NY 11714

Contract Objective

Establish the performance and engineering design of a diffuser augmented wind turbine and determine its potential for commercial sized machines.

Contract Tasks (Accomplishments)

No Activity - All tasks were completed and a draft final report submitted January 1979.

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

Contract negotiations now underway for a follow-on effort to develop an optimally costed system should be completed in May. The draft final report for the previous contracted effort has been reviewed and comments were returned to the principal investigator.

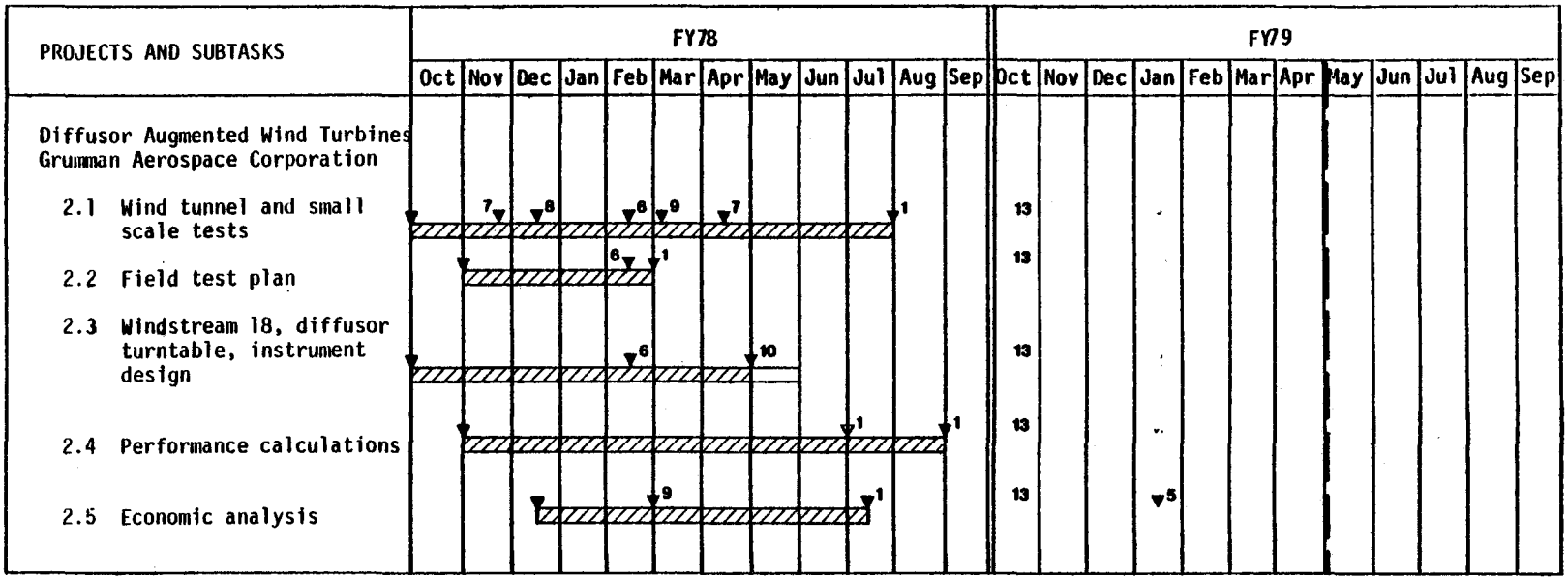


Figure 2-1 FY78 and FY79 Milestone Chart for the Diffusor Augmented Wind Turbines Project

1. Contract Identification: FURTHER INVESTIGATIONS OF DIFFUSER AUGMENTED WIND TURBINES													2. Reporting Period: APRIL	3. Contract Number: EY-76-C-02-2616
4. Contractor (name and address): GRUMMAN AEROSPACE CORPORATION SOUTH OYSTER BAY ROAD BETHPAGE, NY 11714														5. Contract Start Date: SEPT. 30, 1977 6. Contract Completion Date:
7. Months		O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status														
a. NO FY79 FUNDING TO DATE. A FOLLOW-ON EFFORT OF $90 K HAS BEEN PROPOSED AND IS EXPECTED TO BE INITIATED DURING MAY 1979.														e. Actual Costs Prior FYs: $467,931 f. Planned Costs Prior FYs: $467,931 g. Total Estimated Accrued Costs for Contract
Accrued Costs	b. Planned													h. Total Contract Value
	c. Actual													
	d. Variance													

FIGURE 2-2 FY79 Cost Management Chart for the Diffuser Augmented Wind Turbines Program

Project Title: Tornado-Type Wind Energy System Phase II
Contract: Project 3

Number: EX-76-C-01-2555
Start Date: September 27, 1976
Completion Date: August 30, 1979

Contractor: Grumman Aerospace Corp.
South Oyster Bay Road
Bethpage, NY 11714

Contract Objective

Determine technical and economic feasibility of the tornado type machine.

Contract Tasks (Accomplishments)

Completed realignment and calibration of the load cell. Completed rewiring and organization of instrument packaging to eliminate effects on load cell reading. (Task 3.4)

Technical Approach or Work Plan Changes

None

Variances

The major cost variance is a result of the wind tunnel tests not being performed to date. As it is not clear when the tests can be initiated, the cost projection does not reflect that detail. A no cost extension has been approved which changes the contract completion date from June 30, 1979 to August 30, 1979 in order to allow the time for the wind tunnel testing.

Open Items

None

Summary Status Assessment and Forecast

The draft final report for the FY78 funded effort has been submitted and is to be reviewed by July 1979.

The ongoing work is on schedule except for wind tunnel testing. Facilities for the Wind tunnel tests on the large model are still being sought. It is anticipated that the 20-in. diameter tower model will be tested in the V/STOL wind tunnel in June or July 1979.

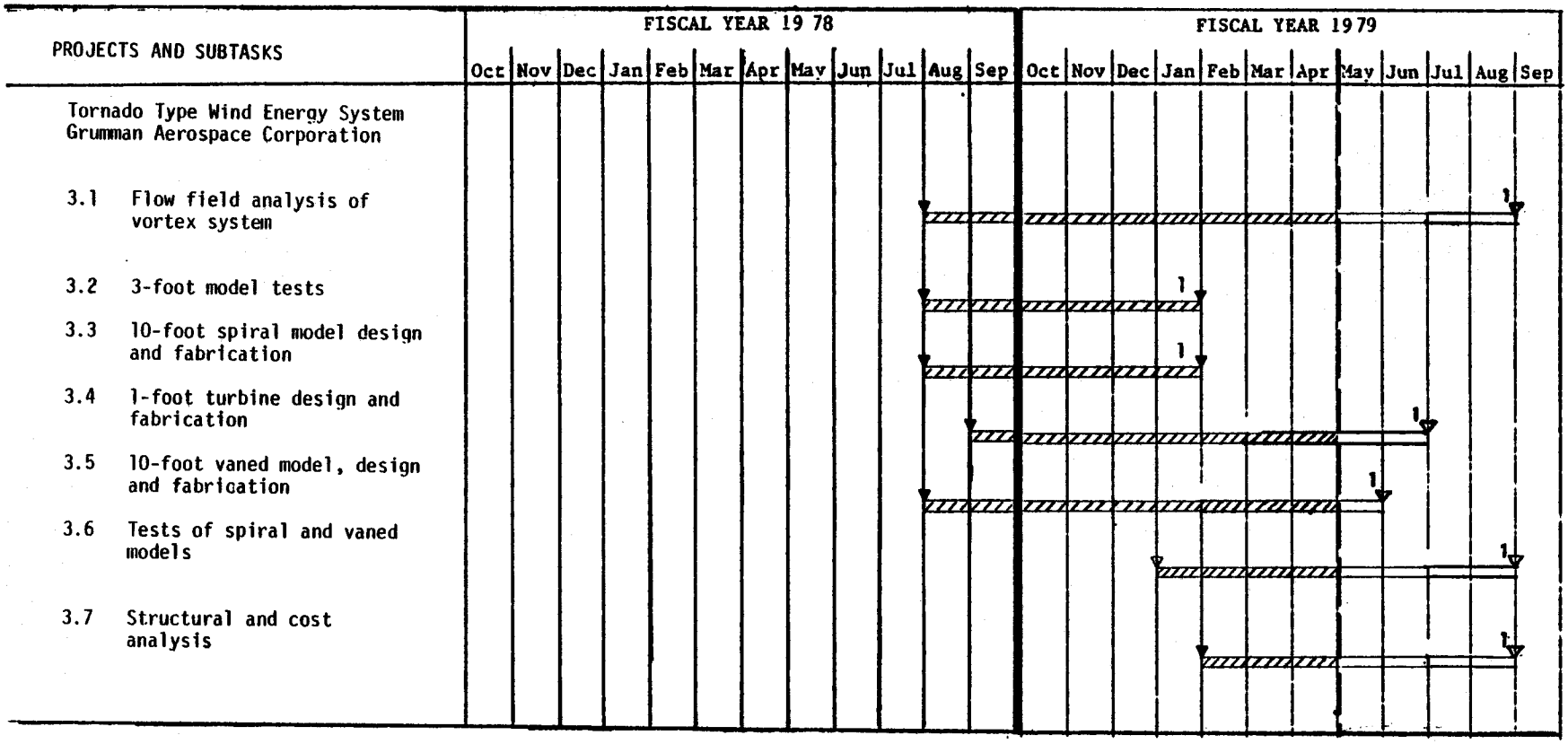


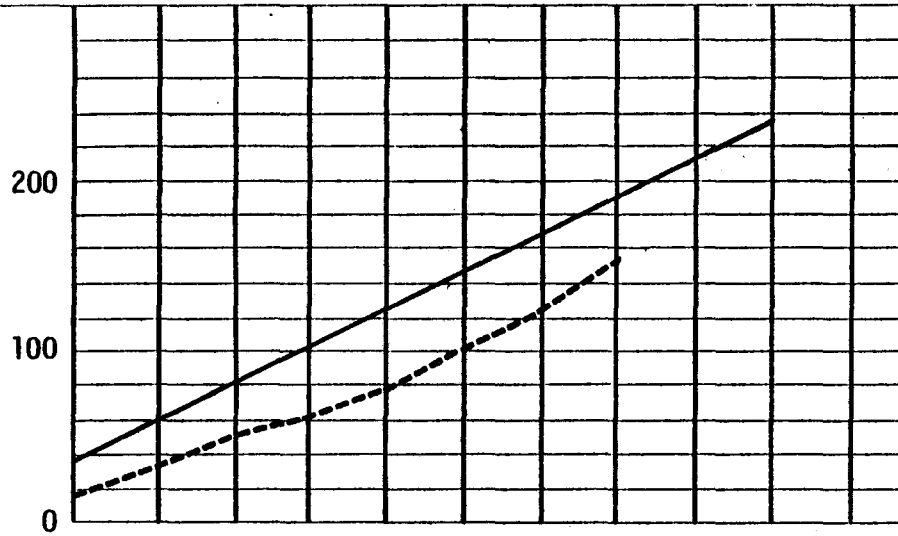
Figure 3-1 FY78 and FY79 Milestone Chart for the Tornado-Type Wind Energy Systems Project

1. Contract Identification	2. Reporting Period	3. Contract Number
TORNADO-TYPE WIND ENERGY SYSTEM	APRIL	EX-76-C-01-2555

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
GRUMMAN AEROSPACE CORPORATION SOUTH OYSTER BAY ROAD BETHPAGE, N.Y. 11714	SEPT. 27, 1976	JUNE 30, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													

a.



e. Actual Costs Prior FYs: $434,710

f. Planned Costs Prior FYs: $434,710

g. Total Estimated Accrued Costs for Contract: $236,115

h. Total Contract Value: $236,115

Accrued Costs ($K)	O	N	D	J	F	M	A	M	J	J	A	S
b. Planned	64	86	107	129	150	172	193	215	236			
c. Actual	33	52	61	79	101	123	154					
d. Variance	-31	-34	-46	-50	-49	-49	-39					

FIGURE 3-2 FY79 Cost Management Chart for the Tornado-Type Wind Energy System Project

Project Title: Test and Devices for Wind/Electric Power Charged Aerosol Generator
Contract: Project 4

Number: EG-77-C-01-2774
Start Date: September 28, 1977
Completion Date: September 27, 1978

Contractor: Marks Polarized Corp.
153-16 Tenth Avenue
Whitestone, NY 11357

Contract Objective

Experimentally evaluate four methods of producing charged droplets and compare the results with available predictions.

Contract Tasks (Accomplishments)

No effort has been expended by the Principal Investigator. All technical tasks have been completed or terminated. (See SERI/MR-13-125)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

The draft final report for the previous effort was not submitted by the principal investigator in April 1979 as planned. The principal investigator has stated that it will be submitted during June 1979.

Summary Status Assessment and Forecast

Contract negotiations for a follow-on effort are expected to be completed during June 1979.

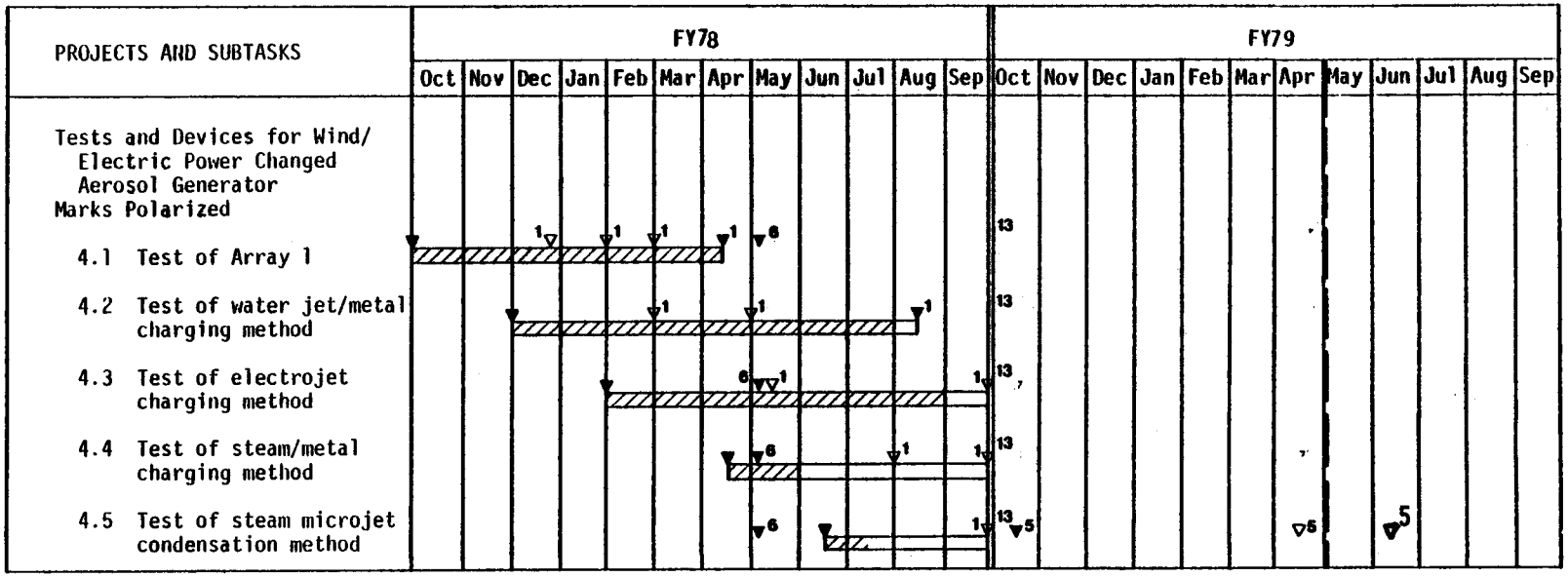


Figure 4-1 FY78 and FY79 Milestone Chart for the Marks EFD Project

1. Contract Identification	TESTS AND DEVICES FOR WIND/ELECTRIC POWER CHARGED AEROSOL GENERATOR	2. Reporting Period	APRIL	3. Contract Number	EG-77-C-01-2774
4. Contractor (name and address)	MARKS POLARIZED CORPORATION 153-16 TENTH AVENUE WHITESTONE, NY 11357			5. Contract Start Date	SEPT. 28, 1977
				6. Contract Completion Date	

7. Months		O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status														
a. NO FY79 FUNDING TO DATE A FOLLOW-ON EFFORT OF $65K HAS BEEN PROPOSED AND IS EXPECTED TO BE INITIATED DURING JUNE 1979.														e. Actual Costs Prior FYs: $199,200 f. Planned Costs Prior FYs: $199,200 g. Total Estimated Accrued Costs for Contract
Accrued Costs	b. Planned													h. Total Contract Value
	c. Actual													
	d. Variance													

FIGURE 4-2 FY79 Cost Management Chart for the Marks EFD Project

Project Title: Electrofluid Dynamic Wind Generator Program
Contract: Project 5

Number: XH-9-8074-1
Start Date: September 15, 1977
Completion Date: March 31, 1980

Contractor: University of Dayton
Research Institute
Dayton, OH 45469

Contract Objective

Provide a sufficient density of charged water droplets of low-mobility to experimentally evaluate EFD generator geometries; and develop techniques for providing low-mobility charged water droplets for wind energy applications in a cost effective manner.

Contract Tasks (Accomplishments)

Investigations of economic charge droplet production methods will be continued and emphasized. (Task 5.6)

Completed a computer search of literature on the production of bubbles and submicron droplets. Conducted studies on the "energy economic" production of charged droplets. Initiated work on the design of a larger diameter electrode generator. (Task 5.6)

Investigate two methods of producing and charging low mobility water droplets in the micron diameter regime. (Task 5.7)

Investigate generator performance by tests and subsequent evaluations using one basic attractor and collector electrode geometry with modifications to the charging section and collecting sections. (Task 5.8)

Identify and suggest solutions to problem areas discovered during efforts in tasks 5.6-5.8. (Task 5.9)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

Completed the revision of the final report on the proceeding contract effort. Submission of the final report to SERI is anticipated during May 1979.

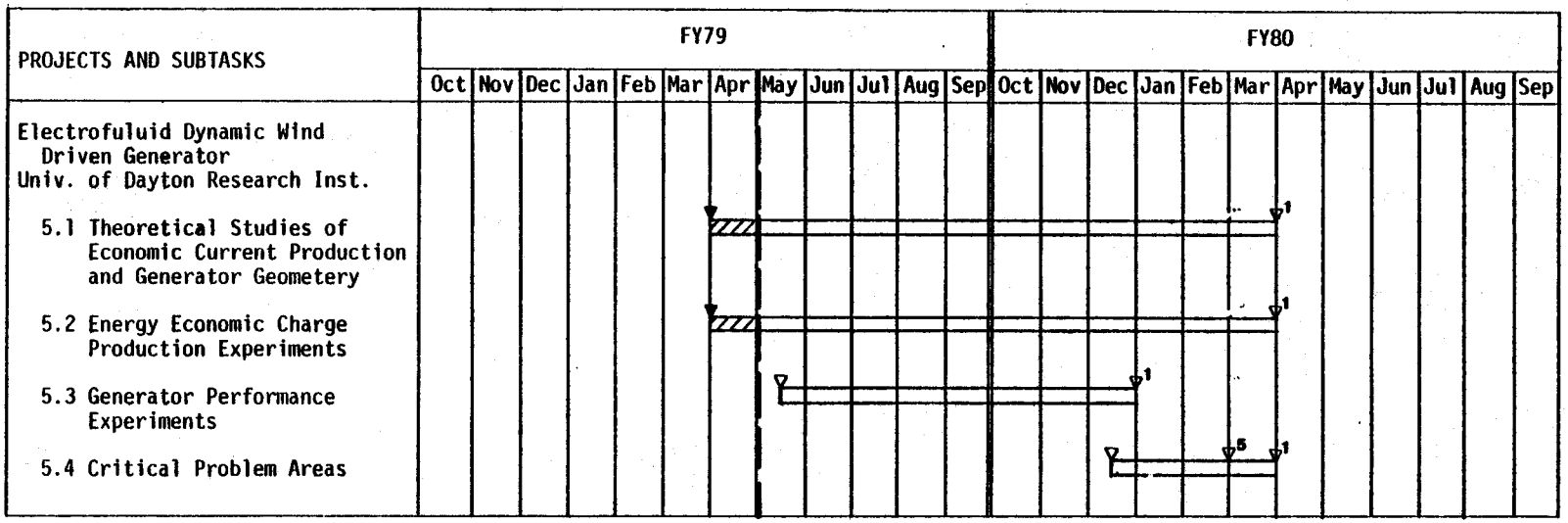


Figure 5-1 FY79 and FY80 Milestone Chart for the Dayton EFD Project

1. Contract Identification	2. Reporting Period	3. Contract Number
ELECTROFLUID DYNAMIC WIND DRIVEN GENERATOR	APRIL	EY-76-S-02-4130

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
UNIVERSITY OF DAYTON RESEARCH INSTITUTE 300 COLLEGE PARK AVENUE DAYTON, OH 45469	SEPT. 15, 1977	MARCH 31, 1980

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a.													
b. Planned							10	20	30	40	50	59	
Accrued Costs ($K) c. Actual							5						
d. Variance							-5						

70
60
50
40
30
20
10
($K)

e. Actual Costs Prior FYs
$314,817

f. Planned Costs Prior FYs
$314,817

g. Total Estimated Accrued Costs for Contract
$117,523

h. Total Contract Value
$117,523

FIGURE 5-2 FY79 Cost Management for the Dayton EFD Project

Project Title: Energy from Humid Air
Contract: Project 6

Number: DE-AC01-79ET23052
Start Date: October 1, 1976
Completion Date: March 12, 1980

Contractor: South Dakota School of Mines and Technology
Rapid City, SD 57701

Contract Objective

Determine a cost effective method of converting the latent heat of water vapor in humid air into mechanical work.

Contract Tasks (Accomplishments)

Develop a computer model to describe this optimally shaped tower to obtain maximum moisture condensation, minimum wall drag, turbulence losses, and flow separation. (Task 6.5)

Investigate wall drag and turbulence losses and modify the computer model to minimize these effects. (Task 6.6)

Investigate condensational dynamics and cooling dynamics to maximize these effects. (Task 6.7)

Conduct a machine design to determine performance, efficiency, size, and geometry. (Task 6.8)

Develop a rough structural design of the machine and evaluate scaling effects on cost and power. (Task 6.9)

Develop, refine, and analyze the economics of this machine using the rough structural design. (Task 6.10)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

Work on the follow-on effort will begin in June 1979. The final report for the previously contracted effort has been delivered and is to be reviewed by June 1979.

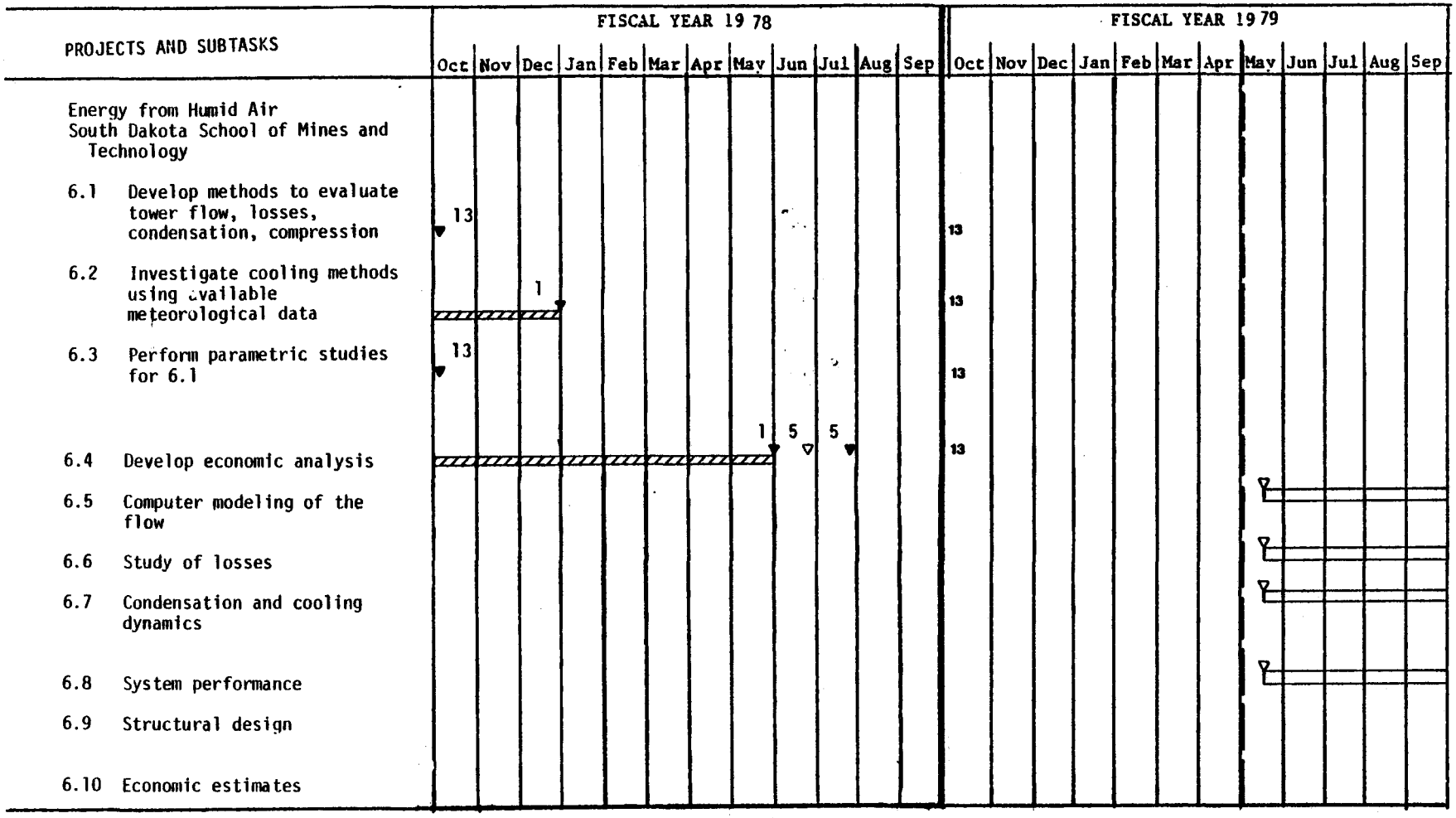


Figure 6-1 FY78 and FY79 Milestone Chart for the Humid Air Project

1. Contract Identification	2. Reporting Period	3. Contract Number
ENERGY FROM HUMID AIR	APRIL	E(49-18)-2553

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY RAPID CITY, SD 57701	SEPT. 20, 1976	MARCH 12, 1980

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a.													e. Actual Costs Prior FYs $168,522
													f. Planned Costs Prior FYs $168,522
													g. Total Estimated Accrued Costs for Contract $ 68,975
Accrued Costs ($K) b. Planned						0	0	0	5	10	14	20	h. Total Contract Value $ 68,975
Accrued Costs ($K) c. Actual						0	0						
Accrued Costs ($K) d. Variance						0	0						

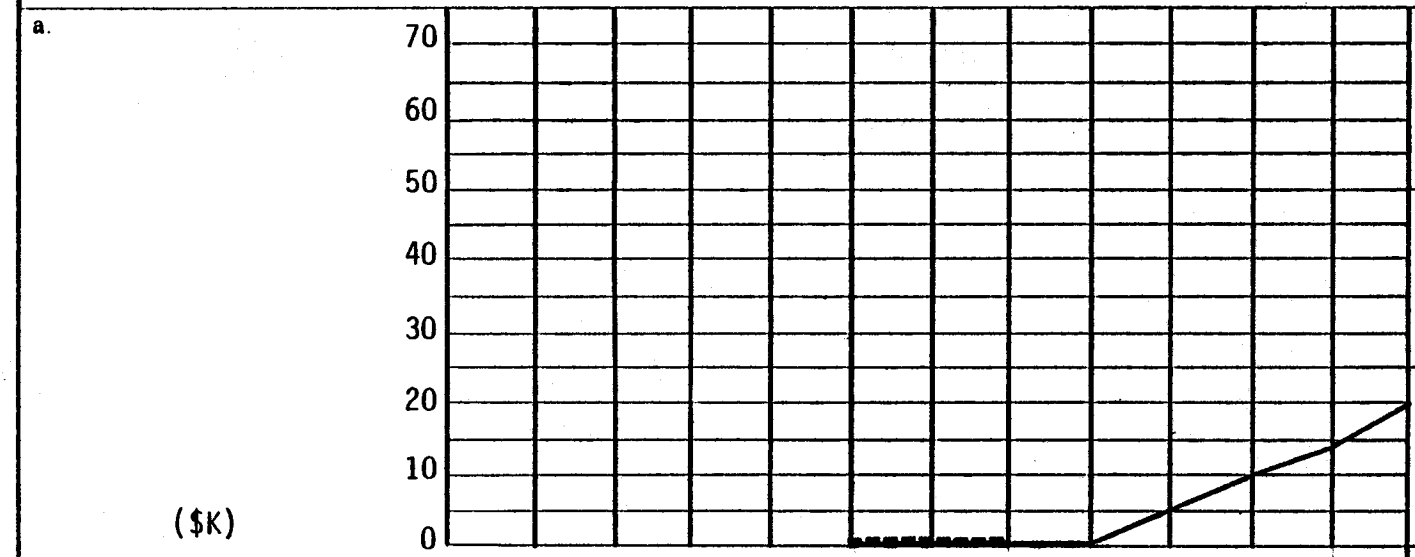


FIGURE 6-2 FY79 Cost Management Chart for the Humid Air Project

Project Title: An Analysis of the Madaras Rotor Power Plant
Contract: Project 7

Number: EX-76-S-01-2554
Start Date: October 1, 1976
Completion Date: May 31, 1978

Contractor: University of Dayton
Research Institute
300 College Park Avenue
Dayton, OH 45469

Contract Objective

Determine the cost effectiveness of the Madaras Rotor Power Plant in the 100 MW to 200 MW Range.

Contract Tasks (Accomplishments)

No Activity - All technical tasks have been completed and the draft final report submitted for review.

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The draft final report has been reviewed and comments returned to the principal investigator. No additional funding has been requested for this study. The final report is to be submitted May 1979.

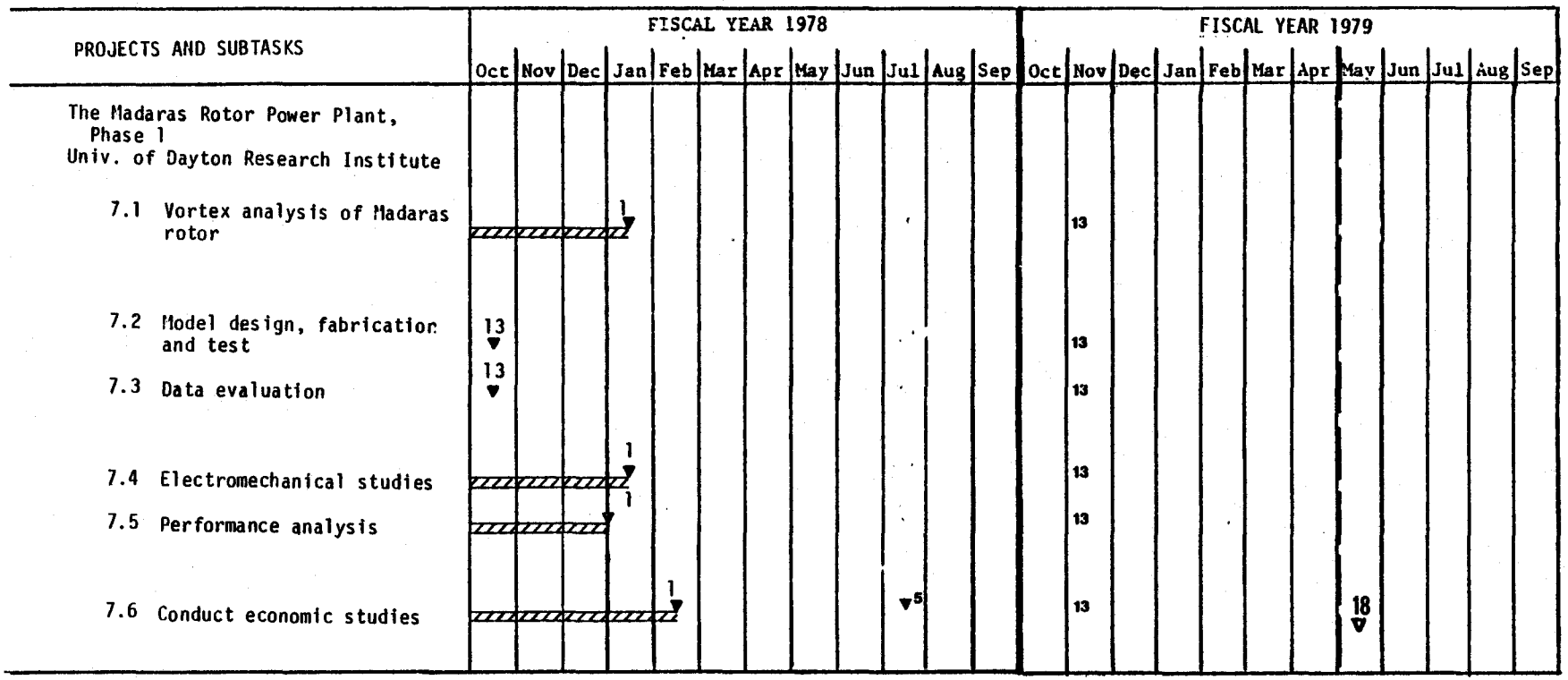


Figure 7-1 FY78 and FY79 Milestone Chart for the Madaras Project

1. Contract Identification	2. Reporting Period	3. Contract Number
MADARAS ROTOR POWER PLANT	APRIL	EX-76-S-01-2554

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
UNIVERSITY OF DAYTON RESEARCH INSTITUTE 300 COLLEGE PARK AVENUE DAYTON, OH 45469	OCTOBER 1, 1976	

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a. NO FOLLOW-ON FUNDING IS PLANNED FOR FY79. NO FOLLOW-ON ACTIVITIES ARE EXPECTED.													e. Actual Costs Prior FYs: $143,170 f. Planned Costs Prior FYs: $143,170 g. Total Estimated Accrued Costs for Contract h. Total Contract Value
Accrued Costs b. Planned													
Accrued Costs c. Actual													
Accrued Costs d. Variance													

FIGURE 7-2 FY79 Cost Management Chart for the Madaras Project

Project Title: Vortex Augmentors for Wind Energy Conversion
Contract: Project 8

Number: ET-77-C-01-2358
Start Date: March 1, 1978
Completion Date: May 31, 1979

Contractor: Polytechnic Institute of New York
Route 110
Farmington, NY 11735

Contract Objective

Determine the technical feasibility, performance, and economic potential of the delta wing type vortex augmentor concept.

Contract Tasks (Accomplishments)

Continued field testing during this period when weather conditions permitted. Stability and control characteristics were unchanged from previous test conditions and safety characteristics were satisfactory. Computer software alterations have been made to account for new sensor deployment. (Task 8.1)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

Field testing is continuing. The project will probably not be completed by May due to the earlier weather delay in testing and will require a no cost extension.

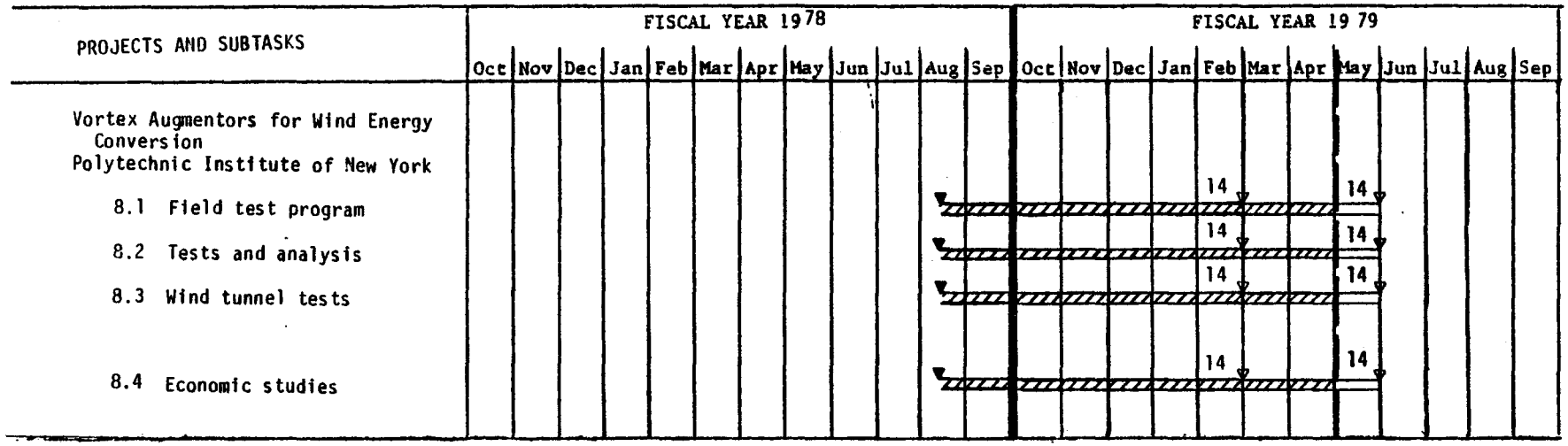
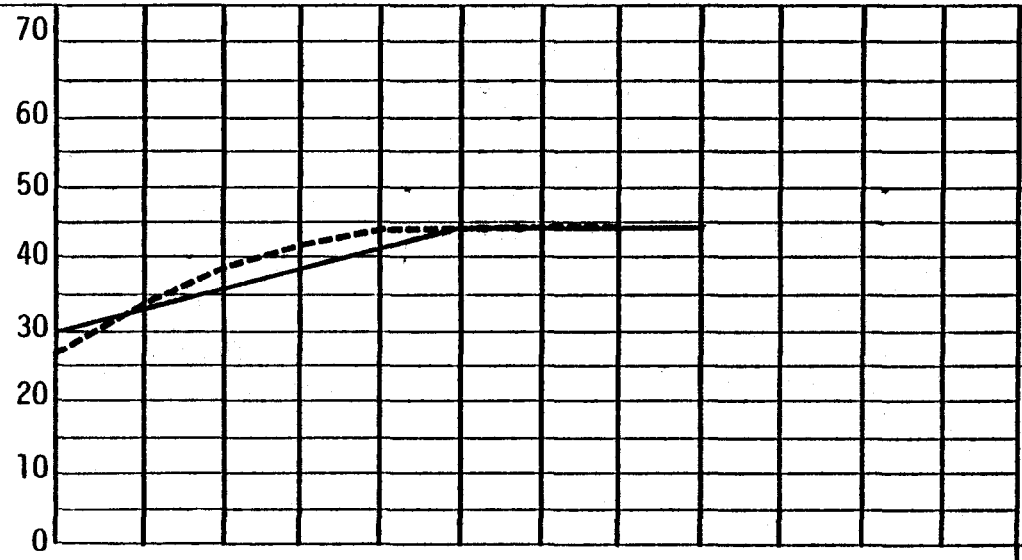


Figure 8-1 FY78 and FY79 Milestone Chart for the Vortex Augmentor Project

1. Contract Identification	2. Reporting Period	3. Contract Number
VORTEX AUGMENTORS FOR WIND ENERGY	APRIL	ET-77-C-01-2358

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
POLYTECHNIC INSTITUTE OF NEW YORK FARMINGTON, MY 11735	AUG. 15, 1978	MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a. ($K)													
Accrued Costs ($K) b. Planned	33	36	39	42	44	44	44	44					
Accrued Costs ($K) c. Actual	34	38	42	44	44	44	44						
Accrued Costs ($K) d. Variance	1	2	3	2	0	0	0						



e. Actual Costs Prior FYs	f. Planned Costs Prior FYs	g. Total Estimated Accrued Costs for Contract	h. Total Contract Value
$336,000	$336,000	$ 43,924	$ 43,924

FIGURE 8-2 FY79 Cost Management Chart for the Vortex Augmentor Project

Project Title: A Definitive Generic Study of Augmented Horizontal Axis Wind Energy Systems
Contract: Project 9

Number: AH-9-8003-1
Start Date: January 30, 1979
Completion Date: May 31, 1979

Contractor: Aerovironment, Inc.
145 Vista Avenue
Pasadena, CA 91107

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of augmented horizontal axis wind energy systems.

Contract Tasks (Accomplishments)

Completed the system analysis of the performance of the Delta Wing and Cost Analysis of the Augmented Horizontal-Axis Systems. (Task 9.1)

Initiated the comparison of conventional Horizontal Axis WES with Augmented Horizontal Axis WES. (Task 9.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is on schedule.

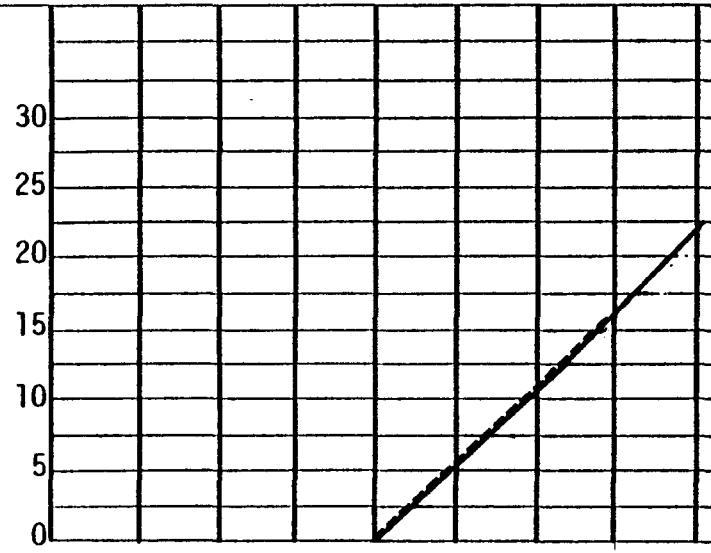
PROJECT AND SUBTASKS	FY79												FY80											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
A Definitive Generic Study of Augmented Horizontal Axis Wind Energy Systems																								
Aerovironment, Inc.																								
9.1 Critical Technical Review																								
9.2 System Comparison																								

Figure 9-1 FY79 and FY80 Milestone Chart for the Aerovironment Augmented HAWT Project

1. Contract Identification	2. Reporting Period	3. Contract Number
A DEFINITIVE GENERIC STUDY OF AUGMENTED HORIZONTAL AXIS WIND ENERGY SYSTEMS	APRIL	AH-9-8003-1

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
AEROVIRONMENT, INC. 145 VISTA AVENUE PASADENA, CA 91107	JAN. 30, 1979	MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY79
9. Cost Status													
a. ($K)													
Accrued Costs ($K) b. Planned					5	11	17	22					
Accrued Costs ($K) c. Actual					5	11	17						
Accrued Costs ($K) d. Variance					0	0	0						



e. Actual Costs Prior FYs	f. Planned Costs Prior FYs	g. Total Estimated Accrued Costs for Contract	h. Total Contract Value
- -	- -	$21,827	$21,827

FIGURE 9-2 FY79 Cost Management Chart for the Aerovironment Augmented HAWT Project

Project Title: A Definitive Generic Study of High Lift Device Wind Energy Systems
Contract: Project 10

Number: AH-9-8003-2
Start Date: January 30, 1979
Completion Date: May 31, 1979

Contractor: Aerovironment, Inc.
145 Vista Avenue
Pasadena, CA 91107

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of high lift wind energy systems.

Contract Tasks (Accomplishments)

Initiated the comparison of several High Lift Devices. (Task 10.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is behind schedule due to a delay in receiving published literature. A no cost extension to June 30, 1979 has been requested to complete the final report.

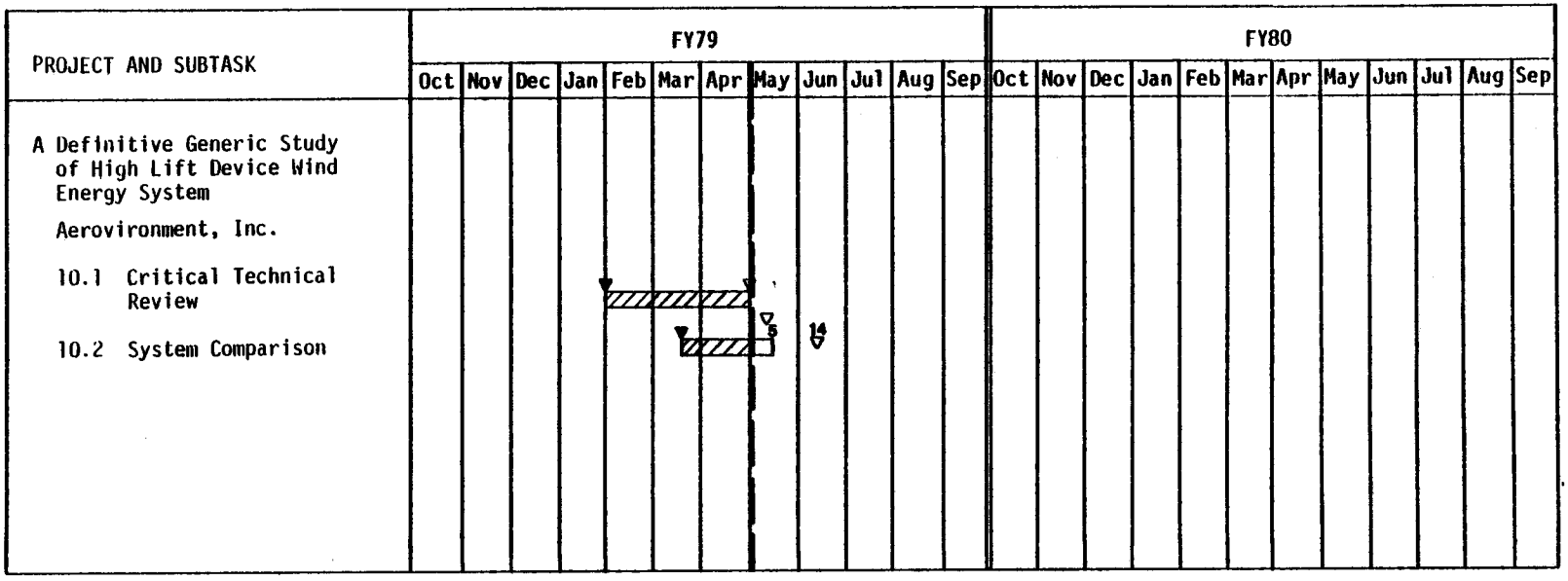
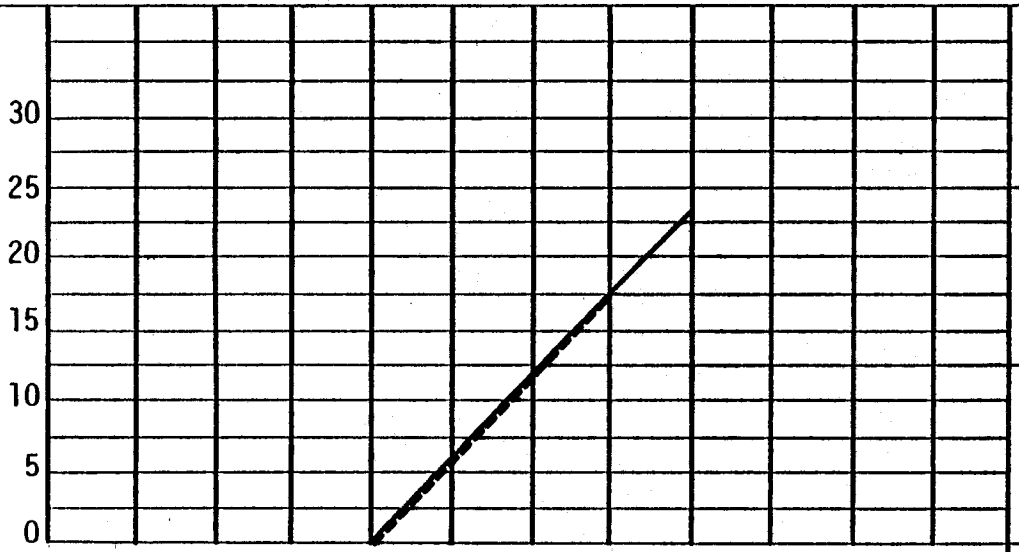


Figure 10-1 FY79 and FY80 Milestone Chart for the High Lift Device Project

1. Contract Identification	A DEFINITIVE GENERIC STUDY OF HIGH LIFT DEVICE WIND ENERGY SYSTEMS	2. Reporting Period	APRIL	3. Contract Number	AH-9-8003-2
4. Contractor (name and address)	AEROVIRONMENT, INC. 145 VISTA AVENUE PASADENA, CA 91107			5. Contract Start Date	JAN. 30, 1979
				6. Contract Completion Date	MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a. ($K)													
b. Planned					6	12	18	23					
Accrued Costs ($K) c. Actual					6	12	18						
d. Variance					0	0	0						



e. Actual Costs Prior FYs: - -

f. Planned Costs Prior FYs: - -

g. Total Estimated Accrued Costs for Contract: $22,772

h. Total Contract Value: $22,772

FIGURE 10-2 FY79 Cost Management Chart for the High Lift Device Project

Project Title: A Definitive Generic Study of Augmented Horizontal Axis Wind Energy Systems
Contract: Project 11

Number: AH-9-8003-3
Start Date: January 26, 1979
Completion Date: May 31, 1979

Contractor: Tetra-Tech, Inc.
1911 Fort Myer Drive
Suite 601
Arlington, VA 22206

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of augmented horizontal axis wind energy systems.

Contract Tasks (Accomplishments)

Continued the critical technical review. (Task 11.1)

Continued the comparison of augmented horizontal axis WES with conventional WES. (Task 11.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is behind schedule due to an increase in the amount of analysis from delayed data accumulation. A no cost extension to June 30, 1979 has been requested to complete the final report.

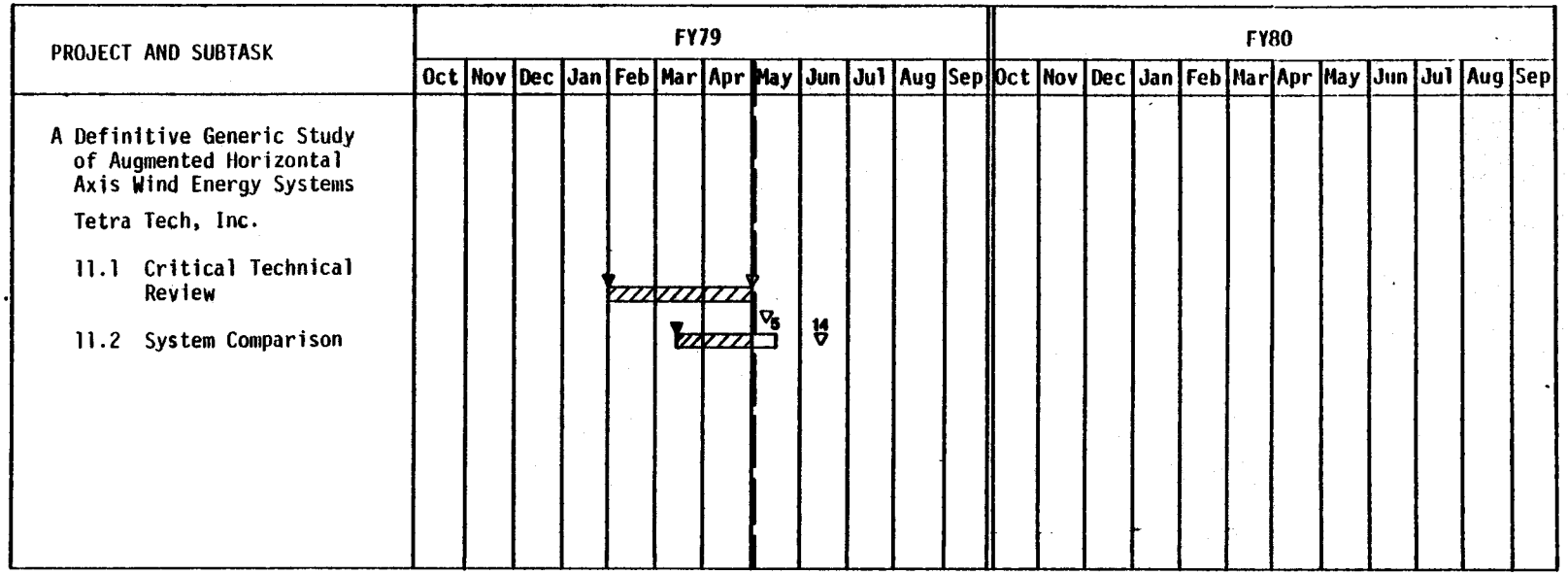


Figure 11-1 FY79 and FY80 Milestone Chart for the Tetra-Tech Augmented HAWT Project

1. Contract Identification		2. Reporting Period	3. Contract Number
A DEFINITIVE GENERIC STUDY OF AUGMENTED HORIZONTAL AXIS WIND ENERGY SYSTEMS		APRIL	AH-9-8003-3
4. Contractor (name and address) TETRA-TECH, INC. 1911 FORT MYER DRIVE, SUITE 601 ARLINGTON, VA 22206			5. Contract Start Date JAN. 26, 1979 6. Contract Completion Date MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a. ($K)													
Accrued Costs ($K) b. Planned					6	12	18	25					
Accrued Costs ($K) c. Actual					6	12	18						
Accrued Costs ($K) d. Variance					0	0	0						

30
25
20
15
10
5
0

e. Actual Costs Prior FYs: - -

f. Planned Costs Prior FYs: - -

g. Total Estimated Accrued Costs for Contract: $24,677

h. Total Contract Value: $24,677

FIGURE 11-2 FY79 Cost Management Chart for the Tetra-Tech Augmented HAWT Project

Project Title: A Definitive Generic Study of Augmented Vertical Axis Wind Energy Systems
Contract: Project 12

Number: AH-9-8003-4
Start Date: January 15, 1979
Completion Date: May 31, 1979

Contractor: New York University
Dept. of Applied Science
New York, NY 10003

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of augmented vertical axis wind energy systems.

Contract Tasks (Accomplishments)

Completed a system cost comparison for Tornado and Lebost Systems. (Task 12.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is on schedule.

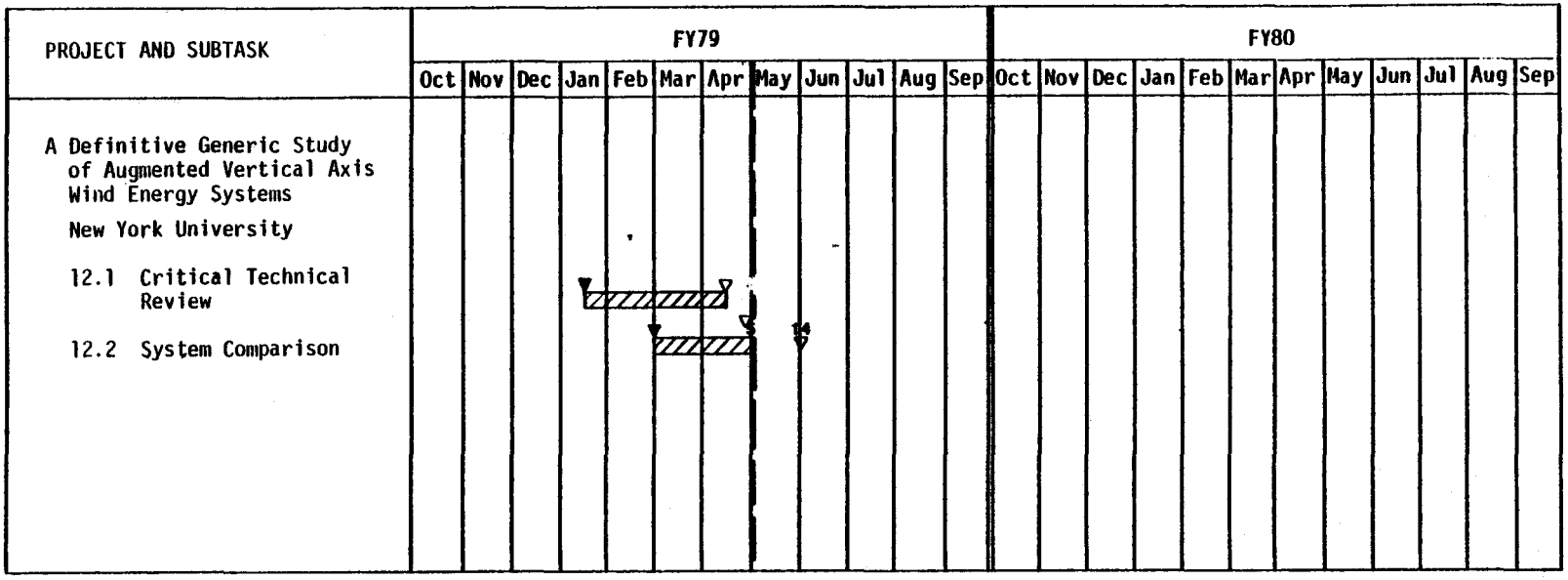


Figure 12-1 FY79 and FY80 Milestone Chart for the Augmented VAWT Project

1. Contract Identification	2. Reporting Period	3. Contract Number
A DEFINITIVE GENERIC STUDY OF AUGMENTED VERTICAL AXIS WIND ENERGY SYSTEMS	APRIL	AH-9-8003-4

4. Contractor (name and address)	5. Contract Start Date	6. Contract Completion Date
NEW YORK UNIVERSITY DEPT. OF APPLIED SCIENCE NEW YORK, NY 10003	JAN. 15, 1979	MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY79
9. Cost Status													
a.													
b. Planned					6	12	18	25					
Accrued Costs ($K) c. Actual					6	12	18						
d. Variance					0	0	0						

($K)

e. Actual Costs Prior FYs: - -

f. Planned Costs Prior FYs: - -

g. Total Estimated Accrued Costs for Contract: $24,951

h. Total Contract Value: $24,951

FIGURE 12-2 FY79 Cost Management Chart for the Augmented VAWT Project

Project Title: A Definitive Generic Study of Sail Wing Wind Energy Systems
Contract: Project 13

Number: AH-9-8003-5
Start Date: January 15, 1979
Completion Date: May 31, 1979

Contractor: Washington University
Tech. Assoc., Inc.
Dept. Mech. Eng.
St. Louis, MO 63130

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of sail wing wind energy systems.

Contract Tasks (Accomplishments)

Completed the critical technical review. (Task 13.1)

Completed the cost comparison of sail wing systems with conventional WES. (Task 13.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is behind schedule and a no cost extension to 30 days after receipt of the SERI draft final comments has been requested. It is anticipated that these comments will be submitted by July 15, 1979 and the contract will be completed August 15, 1979.

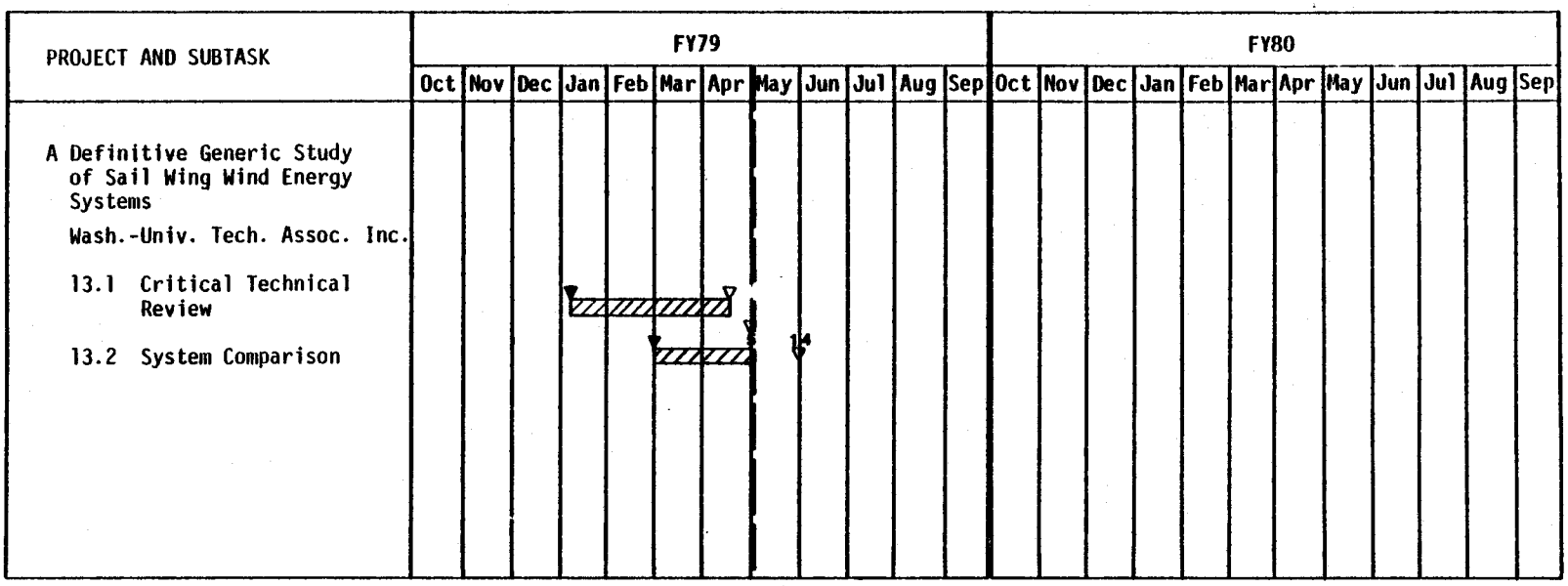


Figure 13-1 FY79 and FY80 Milestone Chart for the Sail Wing Project

1. Contract Identification: A DEFINITIVE GENERIC STUDY OF SAIL WING WIND ENERGY SYSTEMS	2. Reporting Period: APRIL	3. Contract Number: AH-9-8003-5
4. Contractor (name and address): WASHINGTON UNIVERSITY TECHNICAL ASSOCIATES, INC. DEPT. OF MECHANICAL ENGINEERING ST. LOUIS, MO 63130		5. Contract Start Date: JAN. 15, 1979 6. Contract Completion Date: MAY 31, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a. ($K) 30 / 25 / 20 / 15 / 10 / 5 / 0													e. Actual Costs Prior FYs: - -
													f. Planned Costs Prior FYs: - -
													g. Total Estimated Accrued Costs for Contract: $22,500
Accrued Costs ($K) b. Planned					6	12	18	23					h. Total Contract Value: $22,500
c. Actual					6	12	18						
d. Variance					0	0	0						

FIGURE 13-2 FY79 Cost Management Chart for the Sail Wing Project

Project Title: A Definitive Generic Study of Vortex Extraction Wind Energy Systems
Period: Project 14
Contract:

Number: AH-9-8003-6
Start Date: February 15, 1979
Completion Date: June 31, 1979

Contractor: JBF Scientific Corp.
2 Jewel Drive
Wilmington, MA 01887

Contract Objective

Provide a critical evaluation of the potential cost effectiveness of vortex extraction wind energy systems.

Contract Tasks (Accomplishments)

Completed the definition of the baseline configurations for the vortex extraction wind energy systems. (Task 14.1)

Initiated technical evalutions of the Tornado and VAC concepts. (Task 14.2)

Technical Approach or Work Plan Changes

None

Variances

None

Open Items

None

Summary Status Assessment and Forecast

The project is on schedule.

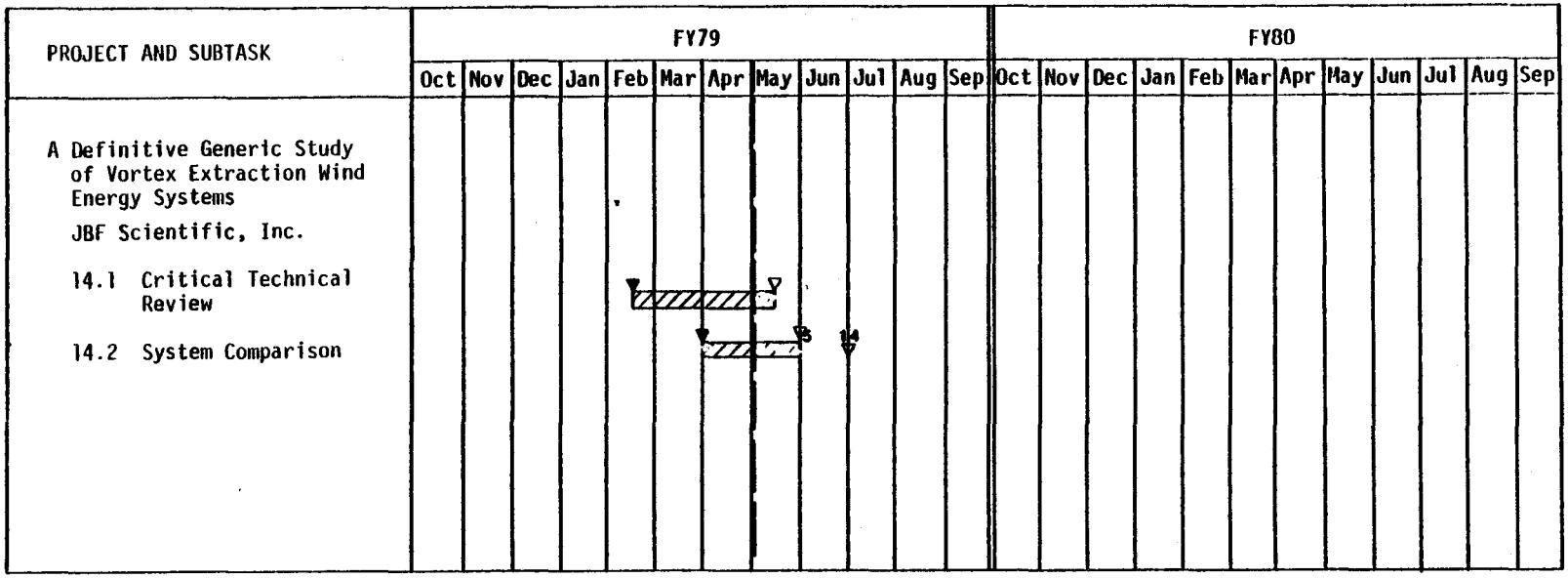
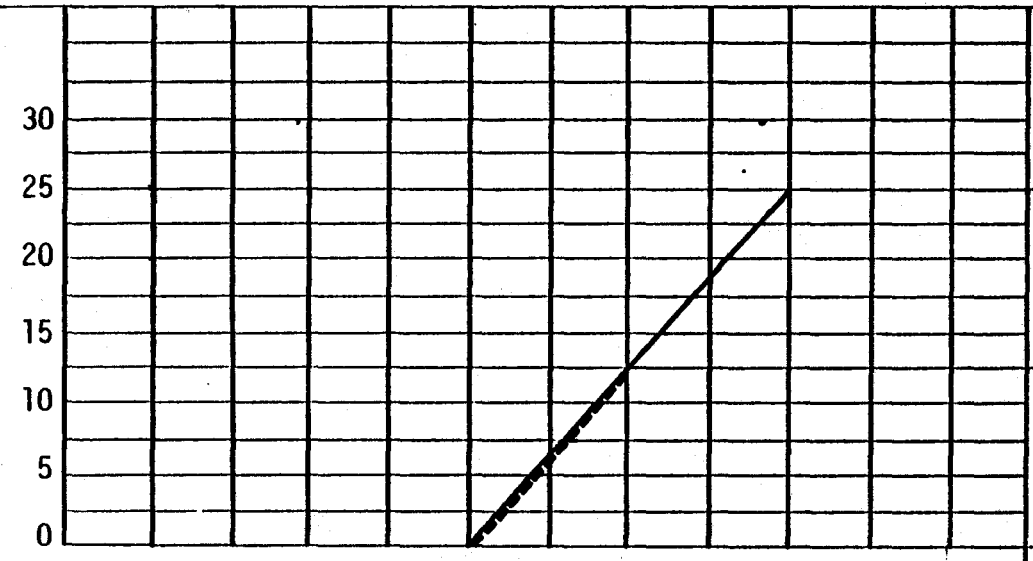


Figure 14-1 FY79 and FY80 Milestone Chart for Vortex Extraction Project

1. Contract Identification	A DEFINITIVE GENERIC STUDY OF VORTEX EXTRACTION WIND ENERGY SYSTEMS	2. Reporting Period	APRIL	3. Contract Number	AH-9-8003-6
4. Contractor (name and address)	JBF SCIENTIFIC, INC. 2 JEWEL DRIVE WILMINGTON, MA 01887			5. Contract Start Date	FEB. 15, 1979
				6. Contract Completion Date	JUNE 30, 1979

7. Months	O	N	D	J	F	M	A	M	J	J	A	S	8. FY 79
9. Cost Status													
a.													
b. Planned						6	12	18	25				
c. Actual						6	12						
d. Variance						0	0						



Accrued Costs ($K)

e. Actual Costs Prior FYs: - -

f. Planned Costs Prior FYs: - -

g. Total Estimated Accrued Costs for Contract: $24,950

h. Total Contract Value: $24,950

FIGURE 14-2 FY79 Cost Management Chart for the Vortex Extraction Project